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# SCIENCE TRENDS

HIGHLIGHTS

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- PUBLICATION CHECKLIST

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## \* LUNAR LANDING LICENSES

Two major developments during the past week bring into focus the civilian-military battle over roles and missions in the space age:

- ✓ The Air Force formally asked industry to work out plans and proposals leading to a military base on the moon.
- ✓ Air Force Systems Commander, Gen. B. A. Schriever bluntly warned that the nation's survival may depend upon military spacecraft and "we should not be inhibited in developing whatever systems are needed..."

♠ Lunar Base: The Aeronautical Systems Division, Wright Patterson Air Force Base, Ohio, made plans to ask proposals in a significant new field of study -- "Technical problem areas as they apply to a lunar traversing vehicle."

The request for proposals (RFP 33-657-62-5109Q) specifies that such a study would be "for the purpose of establishing (1) a preliminary vehicle design concept and (2) a comprehensive research plan that depicts the applied research efforts required before such a vehicle can be experimentally fabricated."

"Such a vehicle," according to the Air Force, "will be required to construct and support a future lunar base complex."

♠ Air Force Vs. NASA: While the Air Force was issuing its call to industry, Gen. Schriever said he is convinced that the national interest in space "can be adequately served by a truly cooperative and mutually supporting effort on the part of the Air Force and NASA", the civilian National Aeronautics and Space Administration. "We must prevent dilution of effort," Gen. Schriever declared, "and avoid unnecessary duplication in the use of our scientific and engineering personnel and our technical facilities."

♠ Who Builds on the Moon?: The Air Force actions are significant in the light of decisions previously endorsed by both the Eisenhower and Kennedy Administrations which are generally understood to give the civilian NASA responsibility for study and development of the manned lunar mission and associated equipment. Presumably a "lunar traversing vehicle" and "future lunar base complex" fit into such a program.

♠ "Artificial Division": Gen. Schriever apparently had such decisions in mind, saying "In the past, our space efforts have been carried out under an unnecessary, self-imposed restriction -- namely the artificial division between 'space for peaceful purposes' and space for military uses."

♠ What Next?: The National Space Council, with its White House ties, is expected to take a closer look at restrictions on military space programs. It remains to be seen whether the civilian space agency agrees to or obtains closer coordination on lunar projects.

\* ARMY TRANSPORTATION RESEARCH PROBLEMS

Here is the latest summary of research and development problems as compiled by the U. S. Army Transportation Command. For a similar compilation of aviation problems, see Washington SCIENCE TRENDS, October 9, 1961. Proposed solutions for these problems are sought from industry, universities, non-profit organizations and individuals.

Comments, inquiries and proposed solutions should be forwarded to:

Chief of Transportation  
ATTN: Director of Research and Development  
Department of the Army  
Washington 25, D. C.

Note: Problem numbers are nonconsecutive because of deletion of prior requirements.

- TC - 35 -- Develop an improved data processing system for coordinating rail, highway, ship, port, and depot operations. (Coordination of Military Sea Transport Service vessel movements, depot shipments and deliveries, and terminal port operations does not achieve maximum efficiency. To meet user requirement dates, many items must be expedited directly from vendor plants or require other special handling to meet terminal shipping dates. A data processing system to determine the depot shipping schedule, cycle times, terminal capacity, and ship tonnage requirements should be developed and refined to provide for wartime and peacetime operations. An ultimate aspect of the development of such a system would be a computer decision of optimum routings, including minimum total cost, priorities, preferred routes, and material priorities. A field-type computer that gives constants and variables to the transport planner in the file is desired. The report "A New Concept of Transportation Movement", published by Stanford University School of Business under Contract DA 44-177-TC-384, is available to define this requirement further.)
- TC - 36 -- Develop a simple, reliable intervehicular signalling device. (Present intervehicular or traffic control communications are accomplished by radio. Radio signals are easily detected, can be intercepted, and represent increasing frequency-allocation problems; the radio itself is expensive, vulnerable, and hard to maintain. A simple, inexpensive, and reliable signalling device that is independent of emission of radio frequency energy is required for intervehicular signalling and traffic control. The device would be applicable to land, sea, and air vehicles.)
- TC - 37 -- Develop a self-contained vehicle wheel drive mechanism. (Conventional transmissions and related powertrain linkages are difficult to maintain in the field. A simple, reliable, sealed power unit is required as a self-contained drive mechanism for vehicle wheels. The units should be easily demountable, replaceable as a standard unit of issue, and designed for disassembly and/or repair at depot level.)
- TC - 40 -- Develop a simple, reliable device to accomplish repetitive steering for vehicles in train formation. (The length, speed, and payload capabilities of logistical trains are limited by the wagon-tongue method of steering. Under this system, train length is limited by successive vehicle encroachment around turns; and the train driver must proceed slowly since he is driving the train rather than his single vehicle. A simple device is needed to transmit steering signals to the successive vehicles in the train so that each vehicle performs the same steering function at the identical point where it was employed by the driver of the lead vehicle. This device would eliminate encroachment around turns and would permit longer trains, greater payloads, and higher speeds because the driver would be guiding the lead vehicle only. The device should permit the backing of a train in such a manner that it can be controlled throughout the backing process.)

\* ARMY TRANSPORTATION RESEARCH PROBLEMS (Continued)

- TC -41 -- Develop an improved arctic transport vehicle concept. (An improved personnel, supply, and tactical vehicle concept that can negotiate the major types of arctic terrain in all seasons is needed. The variables involved are hard rock, solid frozen ground and ice, hard-packed snow, neve (sp. gr. of .2 to 1.5), soft snow (sp. gr. well under .1), deep snow, shallow snow over frozen or unfrozen ground, slush, shallow ponds, deep ponds, floating ice or nonsupporting ice-covered lake or salt water, pressure shore ice (ridges from a few inches to 20 feet or more in height), ice cracks and crevasses (few inches to many feet deep; some water filled and others several hundred feet deep), marsh, muck, floating bog, hummocks in swampy terrain, occasional boulders, gravel, brush, deep moss, shallow-rooted trees, deep lakes, and ice floes. Add to these the varying degrees of slope of the land and all degrees of slipperiness.

The vehicle should be capable of travel over water and of operation in both warm and cold weather (90° to -65°F). Operating periods include wintertime, with continual darkness, and summer, with continual light, as well as more normal alternating day and night. The environment will include other problems, such as insects, wind, drifting snow, blizzards, long-duration ice and rain storms, sun glare, and shadowless invisibility over snow in broad daylight in cloudy weather. If such vehicles capable of supporting military surface movement can be devised, it would further be desirable that they be camouflaged, leave no ice fog or vapor trail in winter operation, and leave a minimum trail across snow or other terrain.)

- TC - 43 -- Develop new unloading systems and accessories to minimize time delays in cargo handling operations. (Auxiliary vehicles should be designed with improved loading and unloading provisions. Instrumentation for small craft, particularly for night operation, should be improved. Significant improvements are also required in conventional shipboard operations to reduce cargo loading and unloading time. Suggested areas for development include high-speed hoist and elevator systems; conveyor equipment of various types; and devices that will adjust to match various ships, docks, and tides. Another suggested development would be a large, 5-ton manipulator by which one man could receive cargo from the pier and place it in its stowed position in the hold or remove hold or remove it from the hold and place it in a lighter or amphibian under adverse weather conditions or place it on the discharge pier.)
- TC - 44 -- Develop improved equipment to make the roll-on/roll-off system of cargo handling more efficient. (The concept of roll-on/roll-off cargo loading of ships is desirable. It reduces the amount of material handling with its attendant damage and eliminates pilferage and loss. The present method of utilizing commercial-type trailers and tractor vehicles has a poor ratio of payload to gross cubage volume because of the space required by the trailer landing gear and undercarriage. In addition to improved rolling stock for roll-on/roll-off operations, there is substantial opportunity for improved ship and shipboard equipment design, including loading and unloading ramps and storage and moving facilities. An immediate problem is that of providing ramp adjustment for the variations in ships, docks, and tides.)
- TC - 46 -- Develop improved methods for unloading in rough water. (Present ships are not capable of being loaded or unloaded in seas where waves are over 4 to 5 feet at shipside. To provide the flexibility needed, these ships should be capable of being unloaded in higher waves. Devices should be developed to control wave action. An alternate concept might provide stabilization of moving platforms aboard ship and lighter with respect to each other. There is a need to reduce the danger of high deck impact from cargo drafts, to facilitate spotting, and to gain safely faster cargo movement in unfavorable weather by methods readily adaptable to conventional cargo ships.)



\* ARMY TRANSPORTATION RESEARCH PROBLEMS (Continued)

- TC - 47 -- Develop means for attaining higher speeds with marine vehicles. (Landing vessels and amphibians are vulnerable because of existing speed limitations. Improvements in absolute speed, of course, are worthless unless the ton-miles per hour can also be increased. This placed a premium on high-thrust generating devices and low-drag support systems.)
- TC - 48 -- Develop or adapt control and guidance systems, where applicable, to marine and amphibious vehicles. (Improved guidance and sensing devices are needed for all types of marine vehicles. Instrumentation should be sensitive to surface and submerged obstacles and hazards to permit all-weather operation. Roll control and suitable automatic trim compensating devices are also required. For beaching operations, a self-propelled, remotely controlled "pathfinder" buoy would be helpful.)
- TC - 49 -- Develop new materials for marine construction and accessories. (There should be an extensive development in plastics and an investigation of high-strength steels and aluminum paneling for marine use. New developments and investigations should aim toward stronger, lighter, and less-expensive construction.)
- TC - 58 -- Develop improved propulsion system for shallow-draft marine craft that does not project below the keel. (Exposed screw-type water propulsion systems limit operations in very shallow water because of possible damage by rocks and other bottom debris.)
- TC - 64 -- Develop improved transmission systems. (The internal combustion engine will continue to play an important role in the projected time period. Even as it gives way to alternate power plants for larger vehicles, scout cars and other small vehicles will retain engines similar to their commercial counterparts. The peculiar load-torque characteristics of this engine will continue to require a transmission of the type with which we are now familiar. Significant improvements in such transmissions are required. At present, clutch mechanisms are a problem. New clutching concepts (for example, using magnetic particles) are needed that are not subject to slippage or fading and that will permit smoother take-up on engagement. Both hydrostatic and hydrodynamic transmissions are used for farm equipment and automobiles. The reliability of these devices must be greatly improved for military use. The adjustable-vane torque converter type of hydrodynamic transmission offers smooth acceleration and relatively high torque at low speed. However, engine braking effort is practically lost on present devices and needs restoring for practical use. For electrical power transmission, current d.c. motors and drives are heavy and bulky, even though lightweight materials have been extensively employed. Some success has been achieved in developing a lightweight a.c. electric generator and drive motor for wheel-drive vehicles. The characteristics of this system allow the elimination of heavy reduction gearing by using frequency control to provide the desired motor speed and torque characteristics.)
- TC - 94 -- Develop an improved method for crossing soft or semifluid terrain. (Wheeled vehicles have proved to be effective in sand, on beaches, and over most temperate-climate terrain under reasonable conditions. However, when the terrain is soft, marshy, or semiplastic, the wheeled vehicle becomes immobilized. The lower ground pressure of the tracked vehicle is a substantial improvement; however, track life is unacceptably short. A gross improvement in methods of overcoming the soft-terrain conditions is needed.)



\* ARMY TRANSPORTATION RESEARCH PROBLEMS (Continued)

- TC - 95 -- Develop vehicle suspension systems that will minimize shock and vibration imparted to cargo during operation over off-road terrain. (In the past, the problem of high-speed operation cross country has been solved by altering the terrain, i.e., by building roads.

Now, with fixed lines of communication becoming less dependable, a new method of suspending vehicles to minimize the terrain-induced shock and vibration must be developed. In high-speed cross-country movement, the shock imparted to cargo and personnel should not exceed the maximum permissible levels for cargo and personnel.)

- TC - 96 -- Develop a system for detecting incipient failure of essential vehicle components (the system to be inherent to the vehicle). (Detection and diagnostic equipment now developed is complex and costly and can hardly be installed in each vehicle. What is desired is a system analogous to an animal nervous system that warns of impending malfunction or failure. The system should be simple and light in weight and should give warnings far enough in advance of failure so that a faulty vehicle would not unwittingly be committed to a vital mission.)
- TC - 97 -- Develop military tires that are resistant to rock bruising, side-wall cuts, cord failure, etc., without reducing the mobility, flexure, or current deflection characteristics. (Large-diameter, low-pressure tires have proven their ability to increase the cross-country mobility of a wheeled vehicle. The ability to change deflection by changing inflation pressure is one of the primary factors in a tire's ability to negotiate various types of terrain. However, it has been found that tire life in cross-country operation is not measured by tread wear but is dependent on the extent of certain carcass types of damage that occur because of rough terrain.)
- TC - 98 -- Develop a pneumatic tire that can negotiate adverse terrain such as drifted snow, sand, mud, plastic soils, etc., and still give acceptable highway life. (For highway operation, the high-pressure commercial tire is quite satisfactory; however, the tire lacks the "flotation" necessary to negotiate soft soils. While aggressive tread patterns (lugs) are helpful in negotiating mud, repeated passes over an area by such tires destroy the soil supporting strength. Aggressive treads lead to increased rolling resistance in sand. The military needs tires of a single design that can give acceptable performance on all soils.)
- TC - 99 -- Develop a method or item that, upon damage of a tire, will provide an emergency movement capability for a vehicle not equipped with a spare tire.

BACKGROUND AND REQUIREMENTS. New vehicles with large-diameter tires are not equipped with spare tires because of the size of the tires and the lack of space on the vehicles. To allow movement of a vehicle to continue after its tires are damaged beyond repair, an item that can be installed by the driver without powered equipment is required. Such an item should occupy approximately 1 cubic foot of space and should be capable of insuring further vehicle operation of 50 or more miles.

- TC - 60 -- Devise a method for improving fuel economy of gas-turbine engines operated at power settings other than the designed or rated power. (Present equipment used by the Army is seldom operated under ideal conditions, and the characteristics of existing power plants are such that they do not provide economic fuel consumption when operated at other than rated power settings. Some investigation to correct this situation is being conducted at present. Greater emphasis is needed in this field, particularly where the gas-turbine engines are concerned. One area of interest is the ability to operate these gas turbines under idling conditions with adequately reduced fuel consumption comparable to that of an idling piston engine. This improved fuel economy will serve to decrease the over-all fuel supply problem.)

\* ARMY TRANSPORTATION RESEARCH PROBLEMS (Continued)

- TC - 65 -- Devise more accurate and dependable means for measuring the power output of piston engines, turboprops, and gas turbines. (The power output of piston engines and turboprops is presently measured by means of torque meters. These instruments measure the torque developed at the output shaft of the engine, and are used as a direct indication of the power output of the engine. In current commercial and military operations, the torque meters are used under all conditions where a knowledge of power output is vital; and they are relied upon implicitly. However, present instruments do not appear to be as reliable and accurate as this dependence would warrant. It is vital to safe and efficient operations that this instrument accuracy and reliability be improved. With the greater emphasis that exists on better turbine-to-propeller transmission of power, and with wider use throughout the Army of turbine-powered equipment, a foolproof torque sensing system is essential. At the present time, the TC, in conjunction with Wright Air Development Division, has a contract to obtain a miniaturized torque sensing transducer. So far, endurance and vibration are within specifications; but there is a zero shift with temperature changes that exceeds specifications. Additional research is required for a reliable system or method.)
- TC - 68 -- Develop replaceable liners for use in containers to permit completely flexible use as carriers for any fuel and lubricant as well as carriers for potable water. (Rolling liquid transporters have been developed and many other fluid transporters are available, but every model must undergo excessive "down time" when the nature of the cargo carried is to be changed. Steam cleaning is usually necessary and in some cases essential. Solutions to this problem will further reduce the POL problem and increase the over-all mobility of Army operations. Currently, the level of achievement is such that nothing has been developed to convert transporters for 40% aromatic fuels into water carriers.)
- TC - 72 -- Develop adequate means for protecting vehicles and personnel on vehicles from the effects of chemical, biological, and radiological (CBR) warfare, and from the radiation from nuclear reactors. (The threat of CBR warfare requires that all vehicles and their crews be adequately protected. Difficulties are apparent when the vehicles used for transport or combat are brought back to base or are serviced in the field. This means that the servicing crews must wear protective clothing or that the vehicles must be decontaminated. Considerable improvements in mobility and operational efficiency will result if an effective vehicle "gas mask" can be devised that will eliminate the need for all but the most elementary of decontamination squads and procedures. There is a requirement for a protection system that includes vehicle-mounted detecting devices with visual or audio alarm provisions. For vehicles that operate in a sealed or closed condition, the operating and fighting compartments should be sealed against chemical and biological attack and the air should be introduced through a filter system. Vehicles with open compartments should have a master filter or an oxygen supply designed to serve individual masks and other protective devices through plug-in connections. The elimination of a significant portion of the massive biological shield now required on nuclear reactors would open many new possibilities in the use of nuclear power for vehicular propulsion. The protection of cargo should be of secondary consideration at this time.

Emphasis should be directed toward the protection of vehicle crews and passenger personnel within an area contaminated by radiological and biological agents poses a problem of providing adequate personnel protection without incurring extreme weight penalties against the vehicle. The problem also points directly to the need for highly specialized personnel carriers with pressurized body compartments to be used to deliver replacement personnel over long distances to their destination in a state of combat readiness.)

(TO BE CONTINUED)

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## TECHNICAL TRENDS

□ The Air Force is thinking of using reservists as "silo sitters" -- manning the underground ICBM bases now being constructed. ✓✓✓ Information is now available on a program which enables university professors to spend from three months to a year conducting research at Government facilities in Oak Ridge, Tenn. while retaining their academic posts, and drawing their regular salaries. For details, write ORINS Research Participation Office, P. O. Box 117, Oak Ridge, Tenn. ✓✓ The Technical Research Division, Federal Communications Commission, Washington 25, D. C. has available single free copies of Report TR-6104 on "Control of Radio Frequency Interference from Nonlicensed Apparatus". ✓✓ The Army Chemical Corps expects to contract for evaluation of chemical compounds which might be used as defoliants or dessicants when sprayed on trees and plants. The project is aimed at jungle and guerilla-type warfare applications.

□ The National Bureau of Standards, Office of Technical Information, Washington 25, D. C. has available a technical summary of its successful redetermination of its primary unit of electrical resistance, with the aid of a nominally 1-picofarad capacitor. ✓✓ The U. S. Bureau of Mines believes that either common salt or water may be superior to ordinary fireclay for stemming or confining coal mine explosives. Single free copies of Report of Investigations No. 5863 on this subject are now available from the Publication Distribution Section, Bureau of Mines, 4800 Forbes Avenue, Pittsburgh 13, Pa. ✓✓ The Joint Committee on Atomic Energy plans to hold subcommittee hearings in mid-November on the domestic raw materials procurement program, including uranium. A schedule will be available from the Committee at F-88, The Capitol, Washington 25, D. C.

□ Hughes Aircraft Co. has won a \$68,500 contract for an elastic sealant compound to be used with liquid rocket fuels at extremely low temperatures. ✓✓ The Army Medical Services Medical Equipment Development Laboratory, Ft. Totten, N. Y. is developing surgical instruments molded from polycarbonate resins for possible use in a national emergency. The plastic instruments are light and durable, and can be manufactured by unskilled labor with speed and economy. ✓✓ The Bureau of Naval Weapons (Code RA-4), Washington 25, D. C. has formally announced that it intends to replace certain Kaman helicopters and Cessna light airplanes with a four-seat helicopter (assault support helicopter) capable of carrying an 800 pound payload at a minimum cruise speed of 85 knots. Operational evaluation is planned for 1963. ✓✓ The Fellowship Office, National Academy of Sciences, Washington 25, D. C. now has available application forms for graduate and postdoctoral fellowships in a number of fields. ✓✓ The Army awarded Ford Motor Company's Aeronutronic Division an \$8 million contract for accelerated development of the Shillelagh surface to surface guided missile system designed for close-in support of troops.

□ The Atomic Energy Commission has extended for five years, and at a cost of \$27.5 million its contract with Phillips Petroleum Co., Bartlesville, Oklahoma for operation of a number of facilities at the National Reactor Testing Station near Idaho Falls, Idaho. ✓✓ A marine version of the Avo-Lycoming T55 gas turbine aircraft engine has been elected to power a new high speed amphibious assault vehicle (LVW, Landing Vehicle Wheeled) to be built for the Marine Corps by Borg Warner Corp. ✓✓ The National Science Foundation, noted for the laxity of its financial operations, has decided to adopt a comptrollership form of organization, which will be under Aaron Rosenthal, formerly director of financial management for the civilian space agency, NASA. ✓✓ The Atomic Energy Commission, Information Office, Washington 25, D. C. has available Announcement IN-259 listing 46 life science research contracts. ✓✓ Qualified scientists and engineers interested in possible temporary overseas assignments are invited to register with the Committee on International Exchange of Persons, National Academy of Sciences, Washington 25, D. C. The Committee, from time to time, receives requests for technical experts -- particularly for lecturing or assistance in setting up a new overseas science or engineering department. ✓✓ A report on possible hazards connected with nuclear reactor control rods containing boron carbide is available as Announcement No. 129 from the Industrial Safety and Fire Protection Branch, Division of Operational Safety, U. S. AEC, Washington 25, D. C.



## P U B L I C A T I O N   C H E C K L I S T

- NASA AUTHORIZATION, a transcript of statements, testimony and exhibits on the many programs of the National Aeronautics and Space Administration for the current Fiscal Year, with particular emphasis on meteorological and communication satellites. 282 Pages. Single Copies free while available. (Write Committee on Aeronautical and Space Sciences, U. S. Senate, Washington 25, D. C. for Hearings - NASA Authorization for Fiscal Year 1962)
- RARE EARTHS AND MONZANITE SANDS, a list of selected references to materials prepared by the Atomic Energy Commission, its contractors and various books and journals. 6 Pages. (Report TID 4900 available through AEC channels or at 50 cents from OTS, U. S. Department of Commerce, Washington 25, D. C.)
- EQUIPMENT DESIGN, a brief report prepared for the Small Business Administration on "Designing for Higher Profits" emphasizing man-machine relationships. 4 Pages. Single Copies Free. (Write Service Department, Washington SCIENCE TRENDS, National Press Building, Washington 25, D. C. for Technical Aid No. 75)
- SIGNAL CONDITIONING, a technical report on instrumentation and signal conditioning requirements for energetic-charged-particle experiment detectors carried by satellites and other spacecraft. 19 Pages. Single Copies Free. (Write National Aeronautics and Space Administration, ATTN: Code BID, Washington 25, D. C. for NASA Technical Note D-1080)
- SPACE ORBITAL RENDEZVOUS, a report from Congress on research required to perfect orbital refueling and other exotic space ventures. 10 Pages. Single Copies Free. (Write Committee on Science and Astronautics, New House Office Building, Washington 25, D. C. for House Report No. 909)
- GUIDE TO COURSES ON NUCLEAR ENERGY, a catalog covering training courses in some 180 Western European universities, technical high schools and research centers. Also lists principal items of equipment. Single Copies Free. (Write Information Office, OEEC European Nuclear Energy Agency, 38 Boulevard Suchet, Paris XVI, FRANCE)
- DIRECT ENERGY CONVERSION, a March 1961 compilation of abstracts in such fields as thermoelectricity, thermionic emission, photoelectric process, magneto-hydrodynamics, fuel cells, etc. 104 Pages. (Report AD 255 294 available through military channels or at \$2.75 from OTS, U. S. Department of Commerce, Washington 25, D. C.)
- LEGISLATION, a transcript of testimony, statements and exhibits relating to such phases of the atomic energy program as European cooperation, liability claims, atomic energy exhibits and possible damage to salt domes from underground tests. 140 Pages. Single Copies Free. (Write Joint Committee on Atomic Energy, F-88, The Capitol, Washington 25, D. C. for Hearings -- AEC Omnibus Bills, 1961)
- HYDROGEN-OXYGEN ROCKET THRUST CHAMBERS, a theoretical study of performance data over a wide range of chamber pressures for hydrogen-oxygen rocket propellant combinations. 82 Pages. Single Copies Free. (Write National Aeronautics and Space Administration, ATTN: CODE BID, Washington 25, D. C. regarding NASA TR R-111)
- AIRPORT TRANSPORTATION, a study report for the Federal Aviation Agency which concludes that helicopters offer the greatest potential of all types of present-day transportation used by passengers between airports and metropolitan areas. 400+ pages. \$5. (Write OTS, U. S. Department of Commerce, Washington 25, D. C. for FAA Report -- "Airport Transportation")

